Evaluation of In-Lake Management Alternatives for Jordan Lake

for

Jordan Lake Committee Meeting #3
Legislative Research Commission

Tom Reeder – Director

Division of Water Resources

March 19, 2014

Measures Reported

- Hypolimnetic Withdrawal
- Dilution
- Phosphorus Inactivation
- Dredging
- Food-Web Manipulation
- Floating Wetlands
- Lake-side Options

Hypolimnetic Withdrawal

- Description – Pump out bottom waters or discharge from dam
- Extent of Science – Few documented case histories
- Where effective – Natural stratified lakes where external nutrient loading has already been reduced

Hypolimnetic Withdrawal (cont'd)

- Limitations
  - Could inadvertently trigger algal blooms
  - Discharge water may require treatment
  - Shifts problem downstream
- Cost-Effectiveness – Moderate cost, effectiveness uncertain
- Permitting – Permits required from US ACE & DWR

Dilution

- Description – Addition of low-nutrient water to the lake
- Extent of Science – Very few documented cases
- Where Effective – Where external sources of nutrients are controlled/diverted and there is close proximity to a reliable supply of low-nutrient water

Dilution (cont'd)

- Limitations
  - Flushing rate of lake
  - Dam outlet structure
  - Downstream impacts
- Cost-Effectiveness – Cost highly variable, effectiveness uncertain
- Permitting – Permit required from US ACE & DWR

Phosphorus Inactivation (Alum)

- Description – Add aluminum salts to water to capture, sink and isolate phosphorus
- Extent of Science – There has been almost no experience using this procedure in reservoirs
- Where Effective – Shown effective in thermally stratified natural lakes where nutrient diversion has occurred

Phosphorus Inactivation (cont'd)

- Limitations
  - Not all P may be removed
  - Can be toxic to fish
  - Found ineffective in impoundments
- Cost-Effectiveness – High initial cost, repeated applications required
- Permitting – Permit required from DWR (and US ACE?)

Dredging

- Description – Scoop or pump out upper sediment layer from lake bottom
- Science – mixed results
- Where Effective – unclear; rarely done for nutrient control in reservoirs

Dredging (cont'd)

- Limitations
  - Destroys bottom habitat
  - Potential resuspension impacts
  - Storage/disposal of dredged material
  - Continued lake inputs means periodic re-do
- Cost-Effectiveness – High cost, uncertain benefit
- Permitting –
  - Dredge – Maybe EA. ACOE 404, DWR 401.
  - Spoil disposal – chemical analysis, DENR approval

Food Web Manipulation

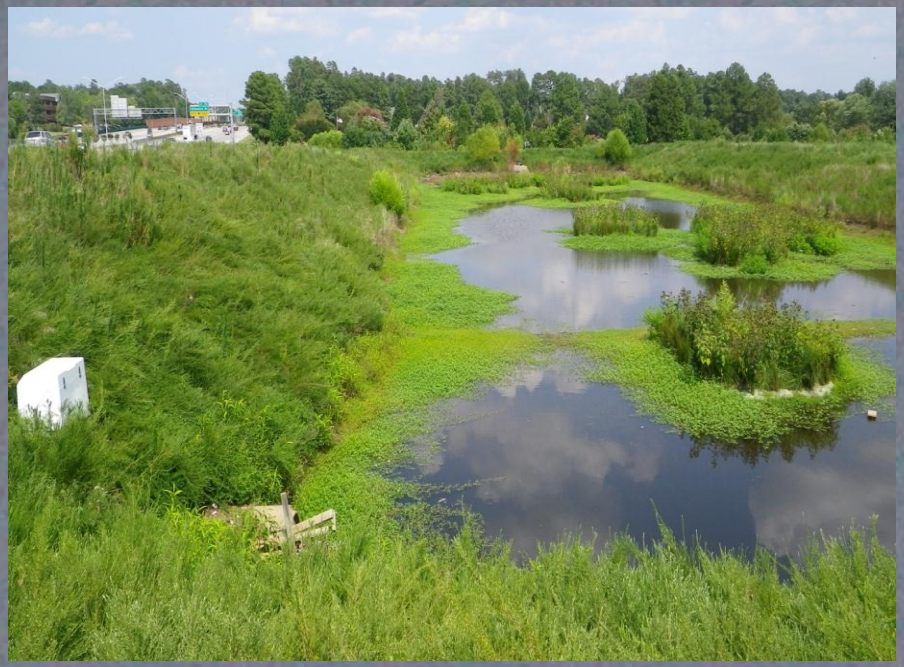
- Description – Alter food web to increase algae consumption
- Science – poorly understood
- Where Effective – Small, shallow natural lakes

Food Web Manipulation (cont'd)

- Limitations
  - Difficult to control ecological systems
  - Continuous management required
  - Potential objections from anglers
- Cost-Effectiveness – Expensive and effectiveness largely unknown
- Permitting – Permit from Natural Heritage?

Floating Wetland Islands (FWI)

- **Description – Man-made floating mats that use plants and microbes to uptake nutrients.**



Photos from NCSU BAE

Floating Wetlands Islands (FWI) (cont)

- Extent of Science – Emerging technology
- Where Effective – Typically in wastewater lagoons in NC, but it's beginning to be studied in stormwater ponds and in larger water bodies around the country.
- Limitations – Large surface area required, could attract geese, potential foothold for undesirable vegetation, ongoing maintenance

Floating Wetlands Islands (FWIs) (cont)

- **Cost-Effectiveness – Further research needed**
- **Regulations/Permitting**
  - **USACE**

Lake-side Treatment Options

- Algal Turf Scrubbers® (ATS™)
- Algae Wheel
- Aqualutions'™ AquaFiber

Algal Turf Scrubbers® (ATS™)

- Description: Water pumped to slightly inclined floways that remove nutrients through algae growth

- Egret Marsh

- HydroMentia's 2.5 acre pilot study

Algal Turf Scrubbers® (ATS™) (cont'd)

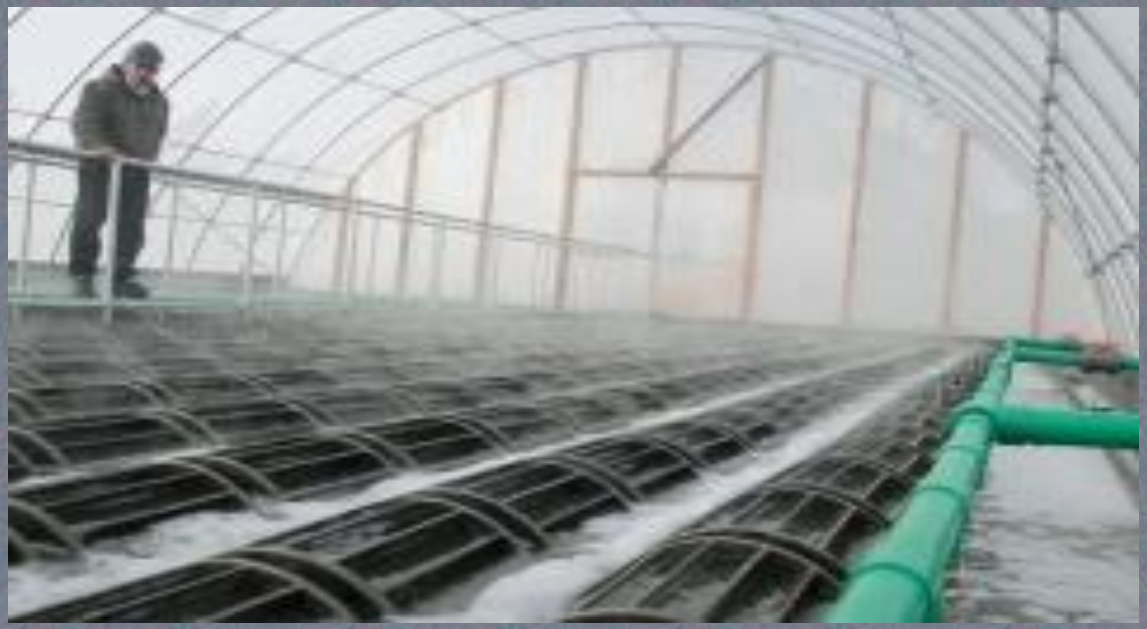
- Extent of Science – Emerging Technology
- Where Effective – Areas with warmer temperature and ample sunlight
- Limitations: Land Area, , Road Access, Power Supply, Piping, Temperature, Topography, Waste Disposal

Algal Turf Scrubbers® (ATS™) (cont'd)

- **Cost-Effectiveness – Potentially cost-effective on small scales**
- **Regulations/Permitting -**
  - **Wildlife Resource Commission - Land**
  - **US ACE - Land**
  - **DWR**
  - **DWM**

Algae Wheel

- **Description: Wheel partially submerged in nutrient-rich water, rotated by air bubbles to promote algae growth with oxygen, bacteria and sunlight.**



- www.progress-index.com Patrick Kane/Staff Photo

Algae Wheel (cont'd)

- Extent of Science – Emerging Technology
- Where effective - Wastewater Treatment
- Limitations - Effective in non-wastewater applications? Only able to handle low flows? Land Required, Power Supply, Piping, Waste Disposal
- Cost-effectiveness – Potentially Cost-effective at small scales
- Regulations/Permitting – Similar to ATS™

AquaLutions™ AquaFiber

- Description – Patented proprietary nutrient and algal removal that uses chemicals and dissolved air flotation.
- Extent of Science – Emerging technology
- Where Effective - Scalable

AquaLutions™ AquaFiber (cont)

- Limitations - Land Area, , Road Access, Power Supply, Piping, Waste Disposal
- Cost-Effectiveness - Potentially cost-effective on small scale.
- Regulations/Permitting - Similar to ATS ™

Contact Information

Tom Reeder
Director, NC Division of Water Resources
919-707-9027
tom.reeder@ncdenr.gov